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(54) Real time status monitoring

(57) In real time status monitoring involving inputting randomly varying data (7) relating to a plurality of objects, processing a plurality of functions having some of the data (7) as variables and monitoring an overall status including the objects on a real time basis, a table (10) indicating the presence or absence of data change in groups of the objects and the presence or absence of variables related to the data change in the functions is used and only those functions which include the variables related to the data change are processed.

Application may be to financial market quotes or traffic control.

FIG. 1

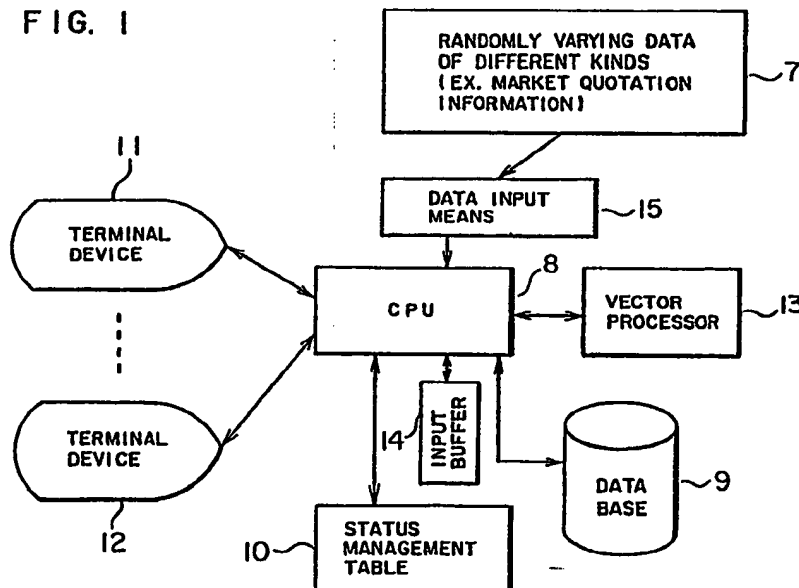


FIG. 1

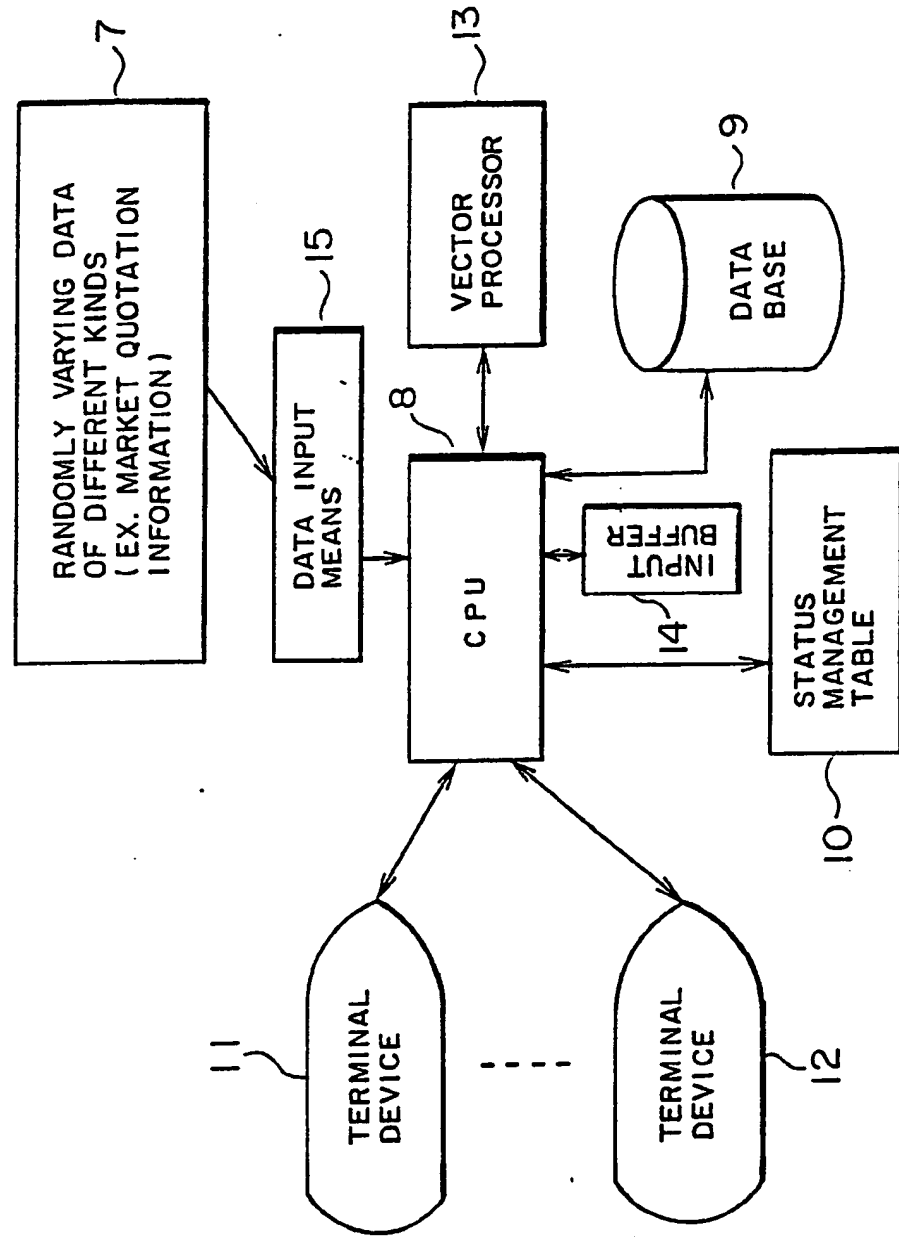


FIG. 3A

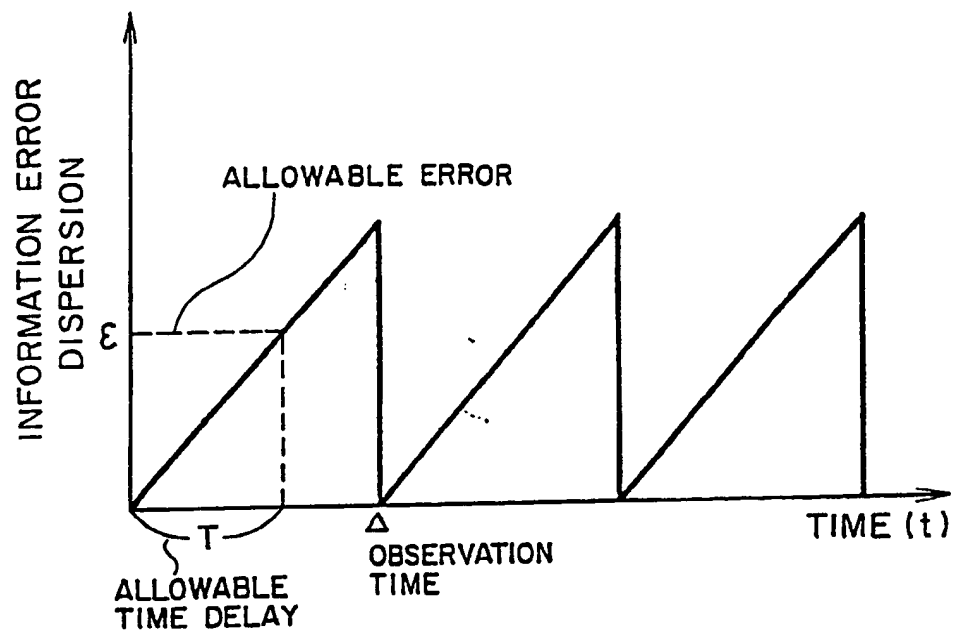


FIG. 3B

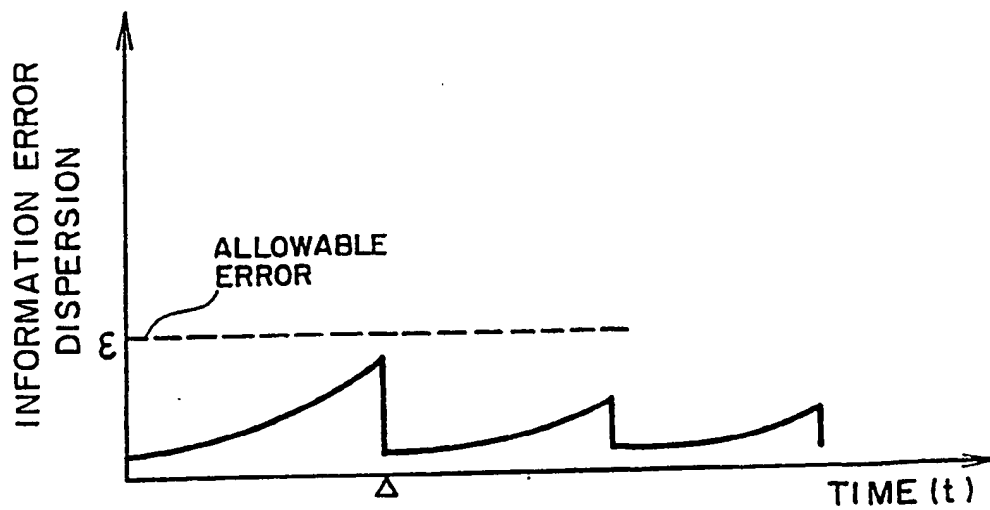


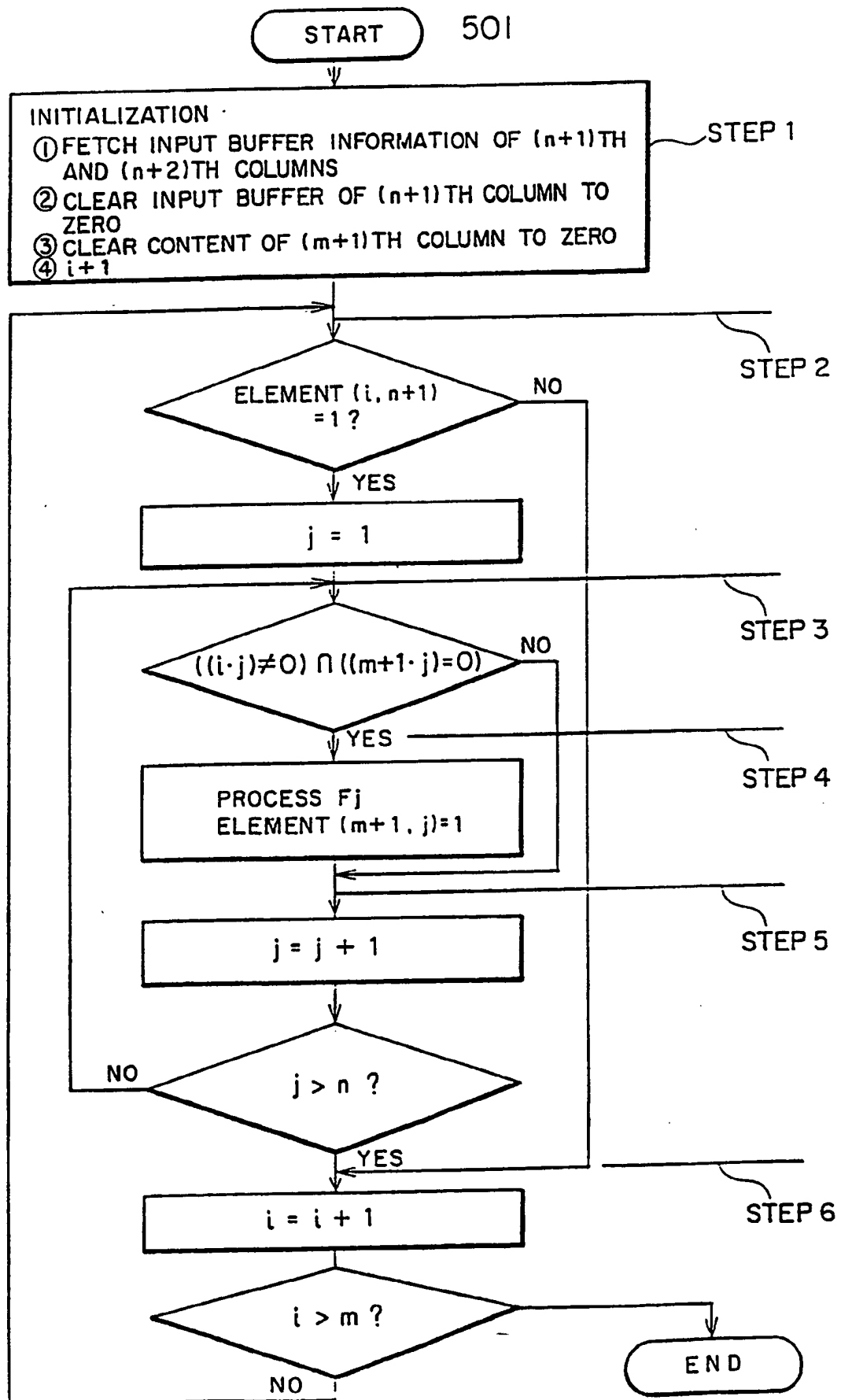
FIG. 4

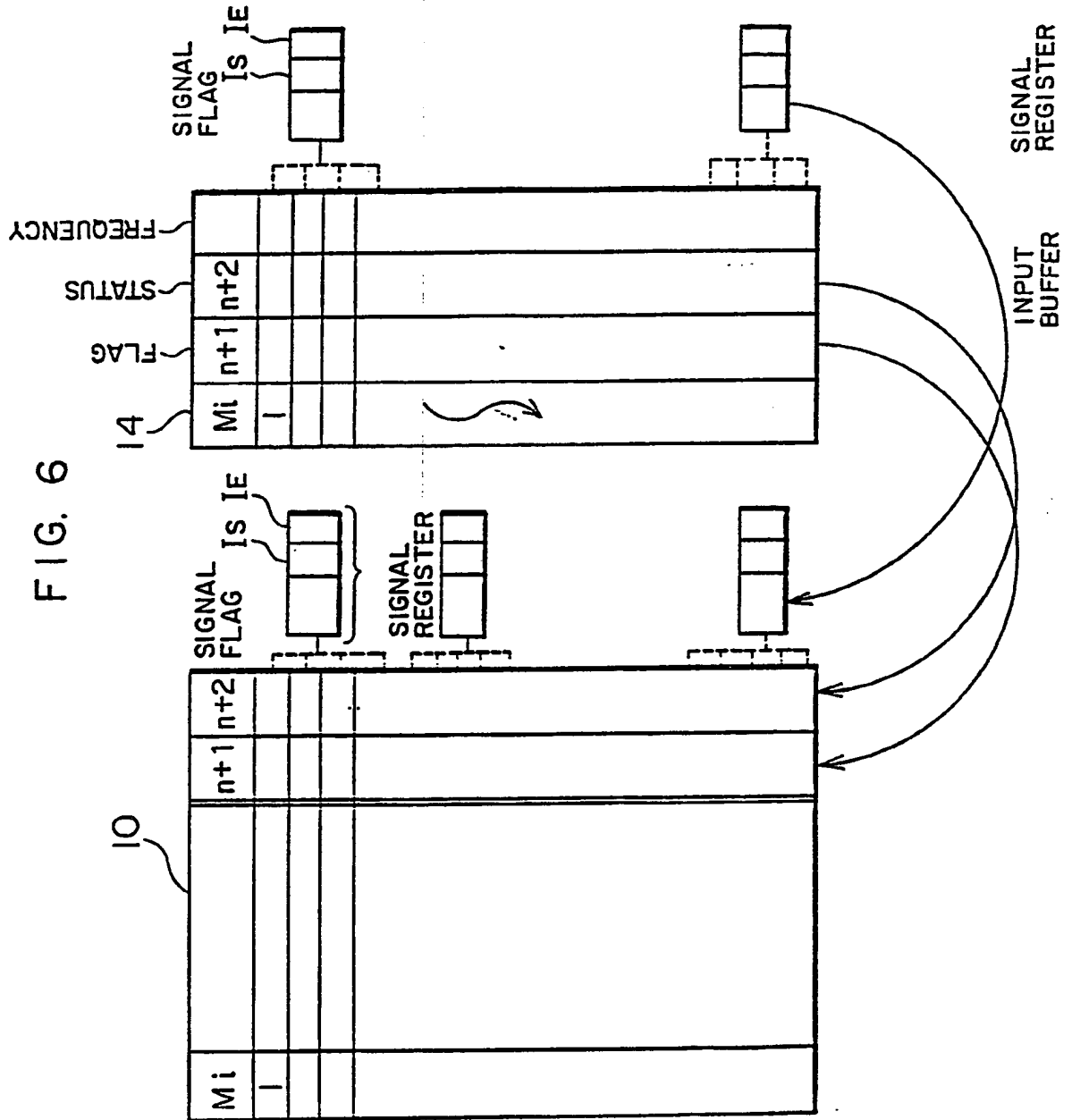
PORTFOLIO NAMES

	PORTFOLIO NAMES					CURRENT PRICE
	F1	F2	F3		F _n	PRICE CHANGE FLAG
M1	w_{11}	w_{12}	0			P1
M2	0					P2
M3	0					P3
	0					
				...		
				w_{1j}		
M _m	w_{m1}					P _m
CURRENT TOTAL AMOUNT UPDATING	1	1	0			
CURRENT TOTAL AMOUNT			f3			
GUARANTEED TOTAL AMOUNT			g3			

FIRM

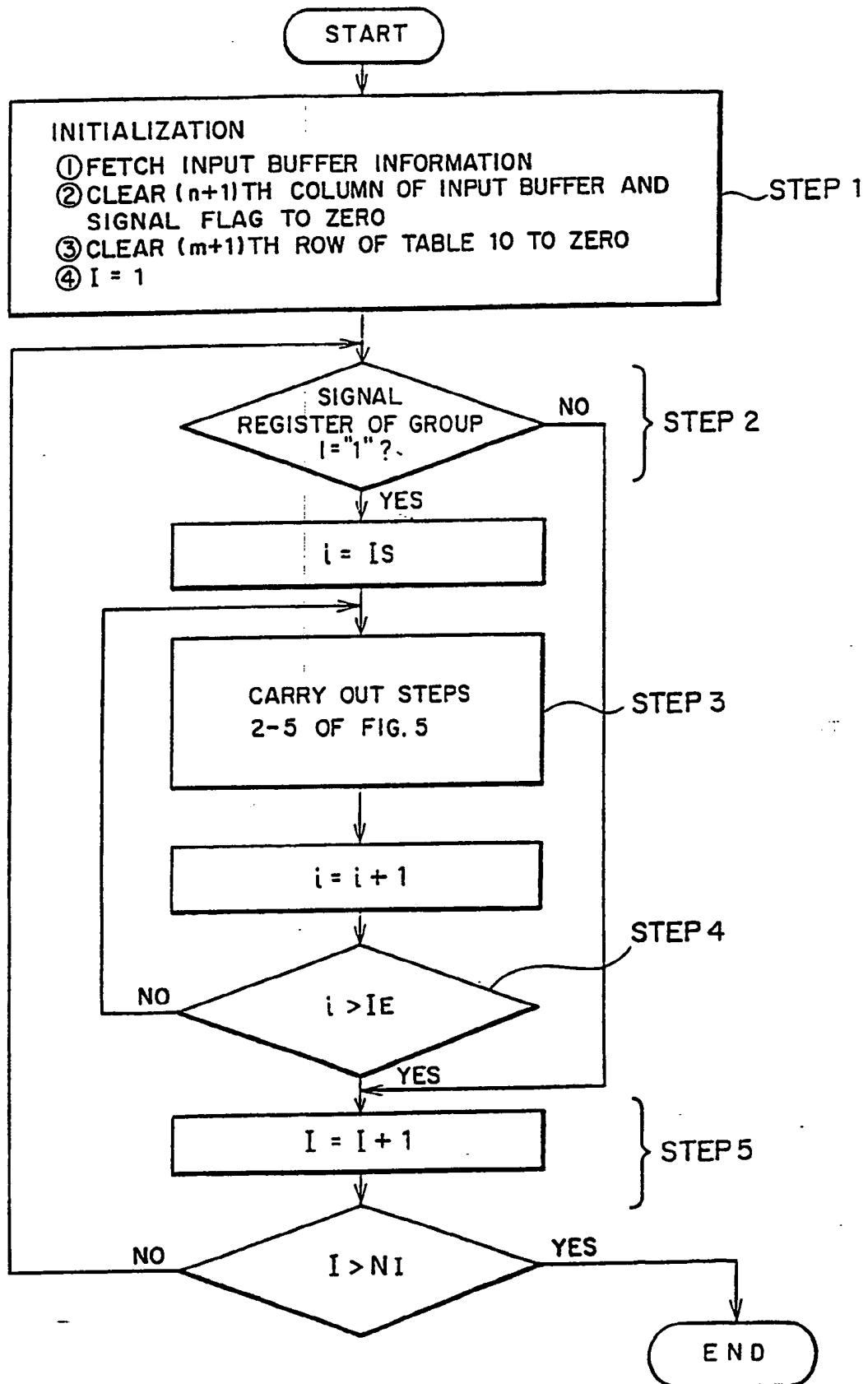
FIG. 5





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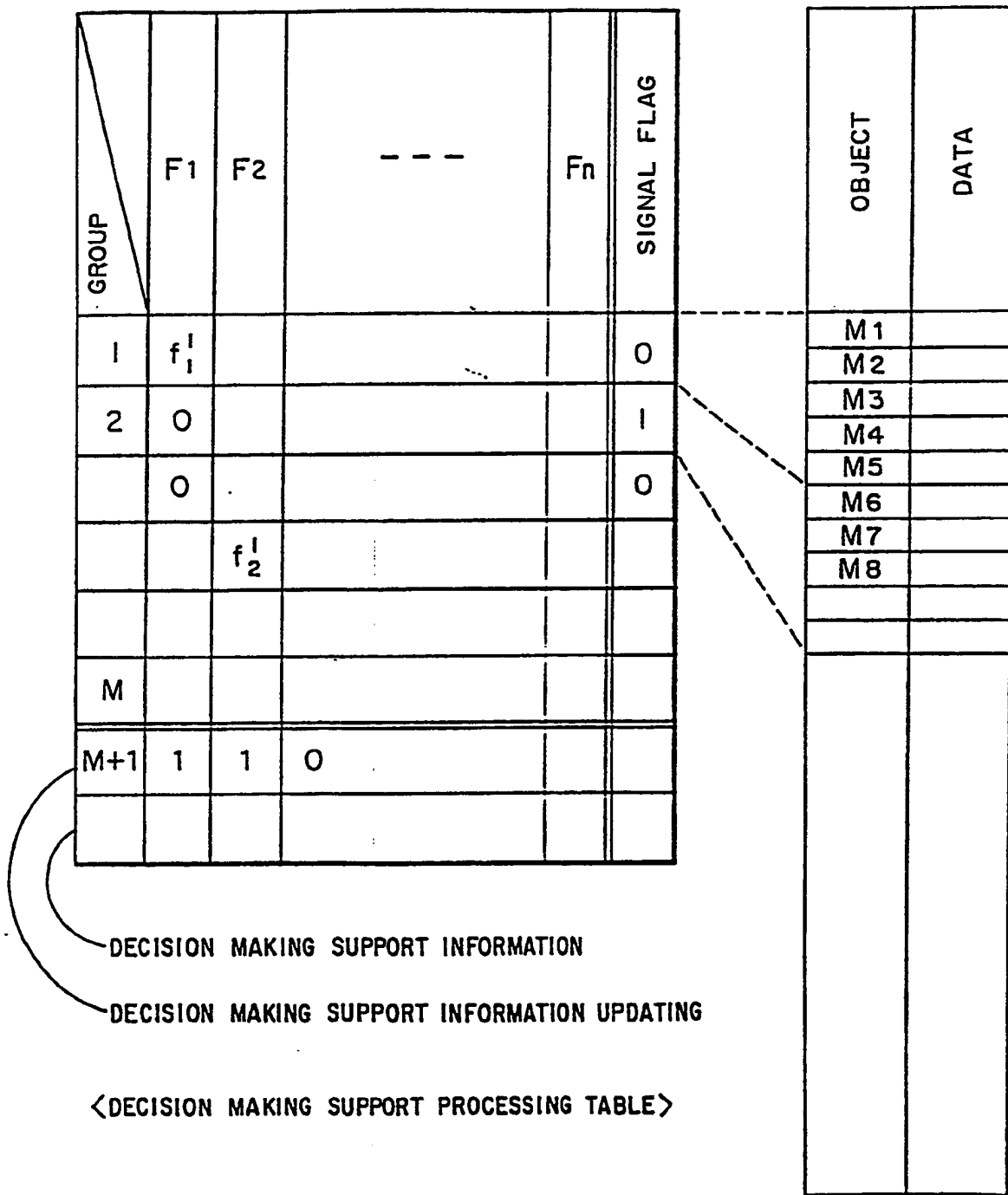
FIG. 7



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FIG. 8

10



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FIG. 9A

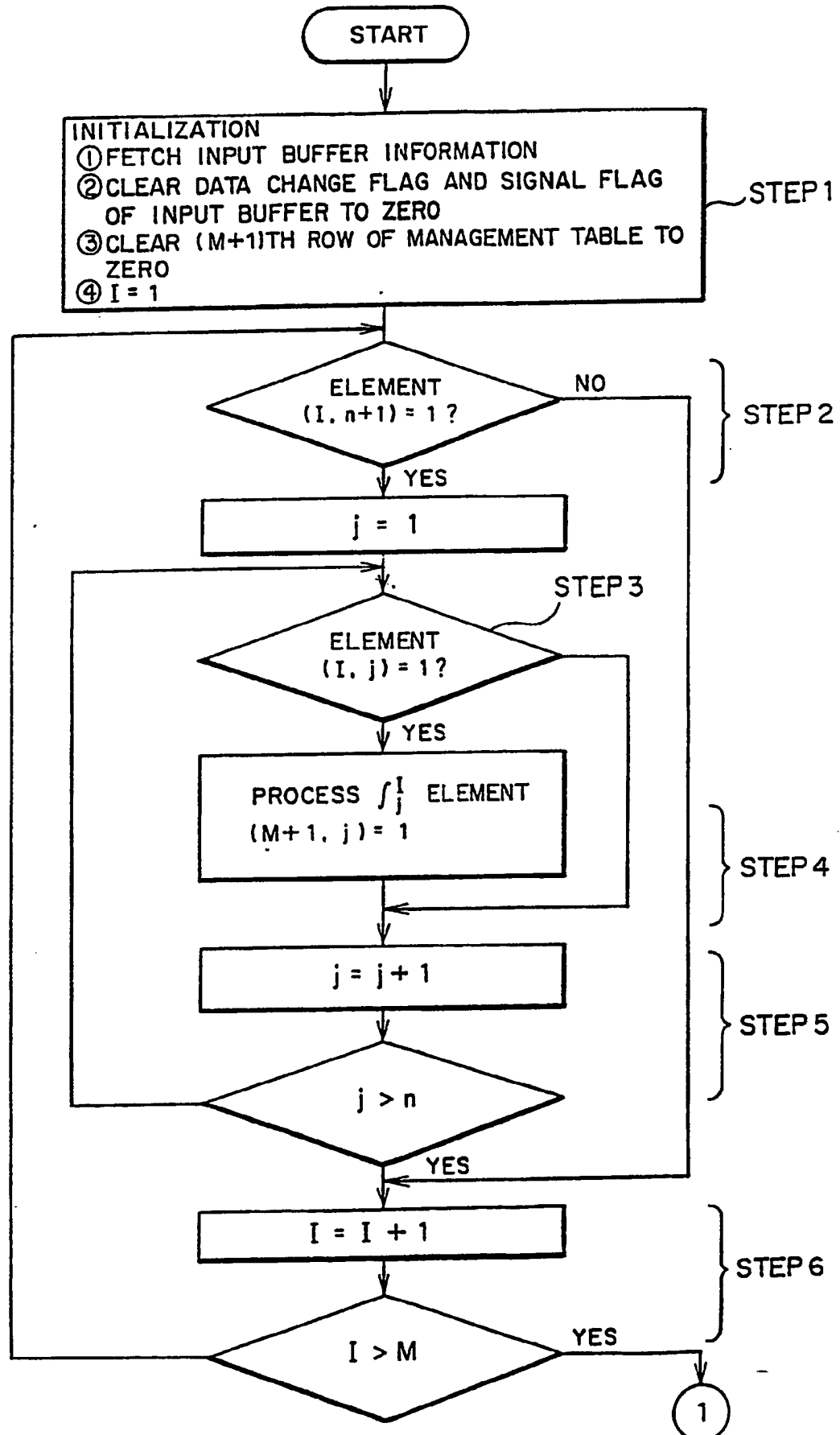


FIG. 9B

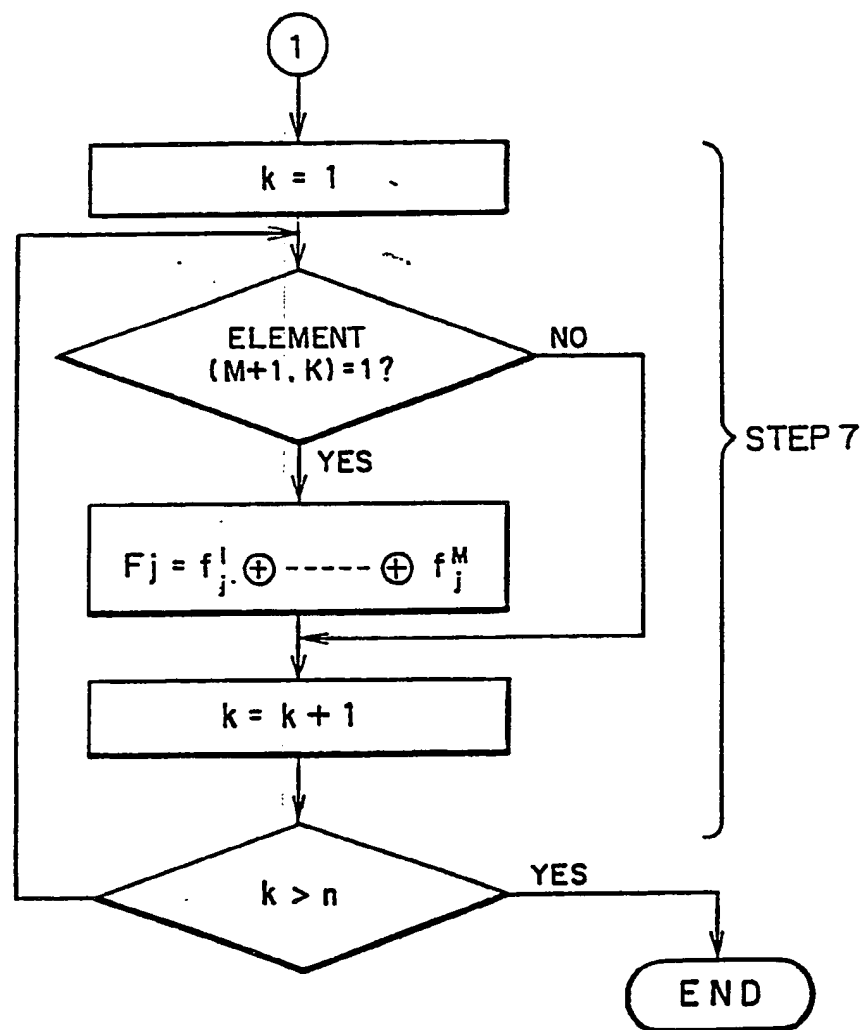


FIG. 10

10

GROUP	F1	F2	---	F _n	SIGNAL FLAG
1	$(f_1^I)^R$				0
2	0				1
3	0				0
		$(f_2^I)^R$			
M					
	0	1			
		$(F_2)^P$			
		F2			

DECISION MAKING SUPPORT INFORMATION

INFORMATION COMPRISING ONLY PAST TIME SERIAL DATA OF (F_j)^P

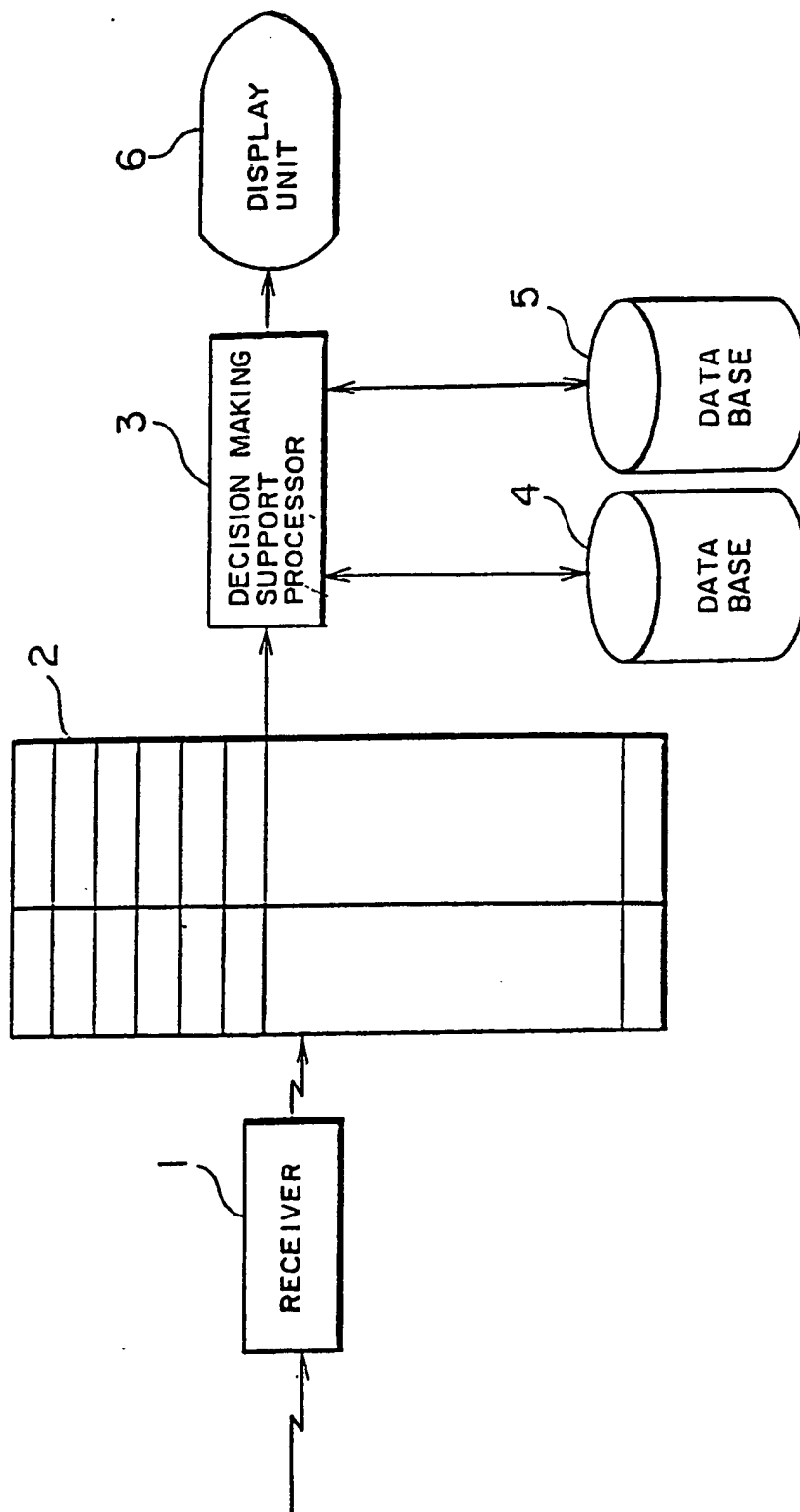
DECISION MAKING SUPPORT INFORMATION UPDAING FLAG

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FIG. 11

FIRM					PRICE CHANGE FLAG		CURRENT PRICE	
	r1	r2		rn				
M1	w11	0			1		P1	
M2					0		P2	
					0		P3	
Mm							~	
yo CHANGE FLAG	0	1	0				0/1	
yo							x0	
A3							At2	
xoyo								
A1								
ri								

FIG. 12



"REAL TIME STATUS MONITORING METHOD
AND APPARATUS THEREFOR"

1

The present invention relates to a real time status monitoring method and an apparatus therefor, and more particularly to a data processing method in a real time status monitoring system which determines a status and makes a decision on a real time basis based on a huge amount of data information which randomly varies with respect to an object, and a system therefor.

Specifically, the present invention is applicable to a trading support system based on market quotation in financial and security fields, a support system for measurement, monitor, control and decision making, comprising a number of sensors, and a support system for status determination and decision making for aviation control or traffic control.

While the present invention is applicable to various fields, it will be explained as a trading support system in the financial and security field.

An outline of the support system for making a decision in accordance with status such as the trading support system in the financial and security field is shown in Fig. 12, in which market quotation information which contains a huge number of varying stock and credit prices is received by a receiver 1, and latest data to be monitored is supplied to a real time status sensing table

1 2 in a system. Two kinds of data bases are provided
corresponding to kinds of informations. Namely, a time
serial data base 4 which contains market quotation
information and a data base 5 which contains information
5 necessary for decision making support processing, for
example, portfolio data of financial assets, are
provided. Based on the market quotation status, a
decision making support processor 3 evaluates the asset
portfolio on a real time basis , determines buying and
10 selling timing by a moving mean method, generates support
information for reassembling the asset portfolio, and
outputs them to a display unit 6. By combining the real
time status sensing table 2 with the data stored in the
data base 4 at a desired time in a desired form, informa-
15 tion for most effective decision to a decision maker can
be generated and provided in accordance with the status.
In this case, there is a time delay between the reading of
the market quotation information and the display of the
information to the decision maker. It is important to
20 reduce the time delay as much as possible.

As a real time processing method applicable to
solve the above problem, a known multi-target tracking
processing method may be used. In this method, multi-
targets to be monitored are observed at a constant time
25 interval and status inferences of all of the multi-targets
are updated based on the observation. ("Improvement in
Correlation Precision in Status Inference Using Multi-
Sensors" by Kosaka et al., SYSTEM AND CONTROL, Vol. 27,

1 No. 8 (1983), "A track correlation algorithm for multi-
sensor integration" IEEE/AIAA 5th DIGITAL AVIONICS SYSTEMS
CONFERENCE, Oct. 31-Nov. 3, 1983, PP. 10.3.1-10.3.8). In
the known multi-target tracking processing, the status
5 changes of all targets to be monitored are always due to
the movement by a physical law. Thus, the status of the
target at any time can be predicted by a Kalman filter
within a certain range of error even if the observation
and the status inference are done at the constant time
10 interval. Accordingly, it is an effective processing
method in an aviation control system and a command and
role system.

The above method may be applied to the decision
making support processing of the trading support system
15 shown in Fig. 12. It is assumed that the market quotation
information (stocks and credits whose data are varying and
prices thereof) has been stored in the real time status
sensing table. Decision making support information
processing groups $\{F_i\}$ are processed at a constant time
20 interval as shown in Fig. 2. All information processing
groups $\{F_i\}$ are processed in accordance with the content
of the real time status sensing table 2 at a time T_i , and
the results are supplied to the display unit. The same
processing is performed to the content of the real time
25 status sensing table at a time T_{i+1} ($= T_i + \Delta T$) which is
 ΔT time later than the time T_i . The time ΔT must be larger
than a sum of processing times for all information
processing groups.

1

It is an object of the present invention to provide a real time status monitoring method which includes less time delay between data input and decision making based on the data, and an apparatus therefor.

It is a specific object of the present invention to provide a real time status monitoring method which receives data relating to a number of objects of different kinds which vary randomly, processes a plurality of functions having data of a portion of the objects as variables and monitors an overall status including the objects on a real time basis, and an apparatus therefor.

The above objects are considered by the inventors in the study about the real time status monitoring method and apparatus. The content of the study is described hereinafter.

In the processing method, it is easy to control the information processing, but the following problem may arise in the trading support system where a huge number of objects are monitored and the data to be monitored change randomly. Of the huge number of objects, there are many objects whose data do not change during the given time period ΔT . Thus, unnecessary calculation process may take place in spite of the fact that the processing result is the same as the previous one. Since the updating time interval ΔT must be larger than the sum of the processing times for all decision making support processings, there occurs a time delay for the generation of the decision

1 making support information. In the case of market
quotation information such as stocks and credits, this
time delay is a very significant factor to degrade the
information because no prediction can be made for a future
5 status as it is done for the tracking processing. As
described in many references, if the price change in the
market quotation occurs in an random walk manner, an error
dispersion of the price is expressed by $\sigma^2 T$ which
monotonously increases with the increase of the time delay
10 T. On the other hand, in the case of tracking processing,
the prediction error of the prediction processing is
increased by the time delay T but the effect is much
smaller than that in the status monitoring of the market
quotation without the prediction processing. The informa-
15 tion error transitions due to the time delay in the status
monitoring of the market quotation and in the tracking
processing are shown in Figs. 3A and 3B, respectively.
Where the huge number of objects are to be monitored and
the changes of data occurs randomly, it is necessary to
20 realize a real time decision making supporting information
processing method which can avoid the unnecessary
processing described above, in order to reduce the
updating process time interval ΔT .

The present invention realizes a system which
25 receives data relating to a number of objects of different
kinds, processes a plurality of functions having data of a
portion of the objects as variables and monitors an
overall status including the objects on a real time basis.

1 The above objects of the present invention are
achieved by a system which receives, the randomly varying
data of a plurality of objects, processes a plurality of
functions having some of the data as variables, and
5 monitors the overall status including the objects on the
real time basis. The system comprises a table which
represents the presence or absence of change of data of
the objects and the functions which includes the variables
which have been varied. The table is referenced when the
10 functions are processed so that only those functions which
include varied data as the variables are processed.

In accordance with the present invention, there
is no need to process the functions at the constant time
interval but the processing is performed only when the
15 data of the variables have been varied, by referencing the
table. Accordingly, in a real time monitoring system in
which data of the variables such as market quotation
information of the stocks and credits vary randomly and
the variation is not frequent, the data processing speed
20 of the system is remarkably improved compared to the known
system. In accordance with the present invention, the
time delay between the data input and the decision making
based on the data is reduced.

The advantage of the present invention is
25 further remarkable when the input data is grouped or the
corresponding functions to the grouped data are divided.
Where the input data is time series data, the time serial
data is divided into a present data component and a past

1 data component, and a calculation result stored in a
memory area is used for the past data component and the
processing is performed only for the present data
component. As a result, the data processing speed is
5 improved and the advantage of the present invention is
prominent.

In accordance with the present invention, high
speed data processing with the same precision can be
attained with a conventional data processing system having
10 a relatively low processing speed, and the time delay
between the data input and decision making can be reduced
even in such a case.

The present invention will now be described in greater detail by
way of examples with reference to the accompanying drawings, wherein:-

Fig. 1 shows a configuration of one embodiment
15 of a real time status monitoring system of the present
invention,

Fig. 2 illustrates a relationship between
objects to be monitored and decision making support
processing,

20 Fig. 3A illustrates information error transition
of support information for decision making based on
status, in status monitoring of market quotation,

Fig. 3B illustrates information error transition
of support information for decision making based on
25 status, in tracking processing,

Fig. 4 shows a format of a status management
table,

1 Fig. 5 shows a flow chart for a real time status
monitoring processing method which uses the management
table of Fig. 4, in accordance with an embodiment of the
present invention,

5 Fig. 6 shows a format of the status management
table where detection of data change in the objects to be
monitored is grouped,

 Fig. 7 shows a flow chart for a real time status
monitoring processing method which uses the management
10 table of Fig. 6, in accordance with other embodiment of
the present invention,

 Fig. 8 shows a format of a management table used
in high speed processing,

 Fig. 9A shows a flow chart for a real time
15 status monitoring processing method which uses the manage-
ment table of Fig. 8, in accordance with other embodiment
of the present invention,

 Fig. 9B shows a flow chart which continues from
Fig. 9A,

20 Fig. 10 shows a format of a management table
used for time serial data processing,

 Fig. 11 shows a format of a management table
when a correlation coefficient is used, and

 Fig. 12 shows a general conceptual chart of the
25 real time status monitoring method and the apparatus
therefor.

1

Fig. 1 shows a system configuration of a real time status monitoring system of the present invention which is applied to a portfolio status monitoring system for calculating a current total price of the portfolio based on market quotation variation information of the stocks and credits and issuing warning when it is smaller than an expected current total price (guaranteed current total price).

10

A central processing unit 8 receives market quotation information informed from a field 7 such as a securities exchange, that is, randomly varying data relating to objects of different kinds, processes various functions (for example, calculation of profit and loss of the retained portfolio, and displays the result on terminal devices 11 and 12. A data base 9 contains time serial data of the market quotation and information associated with the portfolio. A status management table 10 is a main part of the present invention and detail thereof is shown in Fig. 4. In a vertical direction, firm names M_i ($i = 1 \sim m$), a current total amount change flag, a current total amount and a guaranteed current total amount for checking the status of the portfolio are arranged. On the other hand, in a horizontal direction, portfolios F_i ($i = 1 \sim n$), a price change flag (data change flag) and current prices (current stock prices of firms) P_i ($i = 1 \sim m$) are arranged. An element w_{ij} in the matrix management table indicates the number of retained

25

1 stocks or credits of the firm M_i of the portfolio F_j .

For the convenience of explanation, in the status management table of Fig. 4, the firms (objects) are arranged vertically in the matrix $(M_i, i = 1, \dots, m)$, the
5 portfolio names (functions) are arranged horizontally ($F_j, j = 1, \dots, n$), and the elements of the matrix $(w_{ij}, i = 1, \dots, m, j = 1, \dots, n)$ are zero when the functions F_j do not used the data of M_i and not zero when they use the data of M_i . The $(n+1)$ th column contains the price change
10 flags (data change flags). If the price (data) P_i changes in the predetermined time interval ΔT , the matrix element $(i, n+1)$ is "1", and it is "0" in other case. The $(n+2)$ th column contains the current prices, that is, the current prices (data) of the objects M_i . The $(m+1)$ th row contains
15 the current total amount change (function processing) end flags. When the element $(m+1, j)$ is "1", it indicates that the updating of the data of the processing F_j is over, and when it is "0", it indicates that the updating of the data of the function processing F_j is not over.

20 Turning back to Fig. 1, a vector processor 13 rapidly calculates the current total amount by calculating an internal product of the column of the portfolio F_j and the current price.

The operation of the portfolio status monitoring
25 system is now explained.

When the system receives the market quotation information from the field 7, it stores the information into an input buffer 14 and sets the data change flag

1 (current price change flag) to "1". Then, it starts the processing shown in the flow chart of Fig. 5 at the time interval Δt (501).

Step 1: When the updating of the decision making support
5 information (the current total amount and the guaranteed total amount in the $(m+1)$ th and $(m+2)$ th rows) is to be started, the following initialization is effected.

- (i) Read the input buffer information for the $(n+1)$ th column and the input buffer information for the
10 $(n+2)$ th column, from the input buffer 14 to the $(n+1)$ th column and the $(n+2)$ th column of the management table 10.
- (ii) Clear the input buffer for the $(n+1)$ th column to zero.
- (iii) Clear the content of the $(m+1)$ th row of the
15 table 10 to zero.
- (iv) Start the processing of the functions $\{F_i\}$ starting from $i = 1$.

Step 2: Check the content of the element $(i, n+1)$ relating to the price change flag. If it is "0", it means
20 no change in the data of M_i and the decision making supporting process relating to M_i is not necessary. Proceeds to a step 6. If the content of the element $(i, n+1)$ is "1", it means that the data of M_i has been changed and the processing F_j for the steps 3 et seq should be
25 initiated. Start the processing starting from $j = 1$.

Step 3: Check the content of the element (i, j) . If it is "0", it means that the processing F_4 does not relate to the object M_i to be monitored. Proceeds to a step 5.

- 1 If it is not "0", it means that the processing F_j relates to M_i . If the content of the element $(m+1, j)$ is "1", it means that the processing F_j is over. If an AND function of the element (i, j) and the element $(m+1, j)$ is "1",
- 5 proceed to the step 5, otherwise, proceed to a step 4.
- Step 4: Perform the processing F_j in accordance with the status of the object to be monitored in the $(n+2)$ th column. At the end of the processing, set "1" at the element $(m+1, j)$ to indicate the end of the image updating.
- 10 Step 5: Set j to $j+1$. If $j > n$, go to a step 6. If $j \leq n$, go to the step 3.
- Step 6: Set i to $i+1$. If $i > m$, and the process. If $i \leq m$, go to the step 2.

- In the processing of Fig. 5, the portfolio
- 15 current total amount is calculated in the step 3 by the vector processor in accordance with the calculation

$$F_i = \sum w_{ij} \tilde{P}_i$$

- At the end of the processing, the current total amount change flag of the portfolio whose current total amount
- 20 has been changed by the change of the current price of the firm has been set to "1". Accordingly, the current total amount F_i and the guaranteed current total amount g_i are compared for those whose current total amount change flags have been set to "1". If $F_i < g_i$, the current time, the
- 25 portfolio name, the current total amount and the guaranteed current total amount are supplied to the

1 terminal device as the warning message.

In this manner, the real time monitoring of the portfolio is attained.

Fig. 6 shows the contents of the status management table 10 used in other embodiment and the input buffer 14.

Of the huge number of objects to be monitored such as the variation of the market quotation of the stocks and credits, some objects have their data frequently changed and some other objects have their data not frequently changed. For those which have a low frequency of data change, it is desirable to make the number of times of checking the data change flag as small as possible. To this end, the data is efficiently grouped. In the embodiment shown in Fig. 6, the data change detection of the objects to be monitored is grouped.

As shown in Fig. 6, M signal registers each comprising a signal flag (ON = "1", OFF = "0"), a group top item number I_S and a group bottom item number I_E are added to each of the management table 10 and the input buffer 14, and measuring registers for the frequency for the respective objects to be monitored are added to the input buffer 14.

The objects M_i to be monitored are arranged in the descending order of the frequency of data change, and the objects to be monitored are grouped into groups each consisting of N_I objects ($I = 1, \dots, M$) starting from the top object. A signal for detecting the data change in

1 the group is prepared for each group. If all of the data
change flags of the objects in the group are "0", the
signal flag for the group is "0", and otherwise it is
"1". Thus, the signal flag is checked and if it is "0",
5 it may be determined that no data change is included in
the objects of the group without checking the data change
flag of the group. Only when the signal flag is "1", the
data change flags of the objects in the group are checked.

The number of times K_1 of check when no
10 grouping is effected is given by

$$K_1 = m + \sum_{i=1}^m P_i \cdot n$$

where P_i is a probability of data change in the time
interval ΔT of the object M_i . An expectation value K_2
for the number of times of check when the plurality of
15 signal flags are provided is given by

$$K_2 = M + \sum_{I=1}^M (N_I + \sum_{i=I_S}^{I_E} P_i \cdot n) \cdot Q_I$$

where I_S and I_E are the item number i of the top
object M_i to be monitored in the I -th group and the item
number i^* of the last object M_{i^*} to be monitored, and

20 $I_S = \sum_{K=I}^{I-1} N_K + 1,$

1 $I_E = \sum_{K=1}^I N_K$, and

Q_I is a probability that the signal flag for the detection of the status change in the I -th group is "1", that is,

$$Q_I = 1 - \prod_{i=I_S}^{I_E} (1 - P_i)$$

5 It should be smaller than K_1 , and K_2 should be minimum. The value of K_2 depends on the number of signal flags and the grouping method if the probability of the status change is larger when the item number is smaller. Accordingly, it is necessary to monitor the occurrence of the
10 status change of the objects M_i to be monitored and optimize the grouping based on it. If the grouping is not proper, the number of times of check may rather increases.

The processing method of the present embodiment which uses the table 10, the input buffer 14 and the
15 signal registers is explained for the following three steps.

(1) Data change input of the object to be monitored

Since the data change in the object to be monitored is informed from time to time, the flag of the
20 input buffer 14 corresponding to the informed firm M_i is set to "1", the status amount is stored, the data change frequency register is counted up, and the corresponding signal flag is set to "1".

1 (2) Information Processing {Fj}

The updating of {Fj} for each period is effected in the following manner.

Step 1: The following initialization is effected.

5 (i) Read the input buffer information for the (n+1)th column, the input buffer information for the (n+2)th column and the signal flag into the corresponding area of the management table.

(ii) Clear the content of the signal register
10 corresponding to the input buffer for the (n+1)th column to zero.

(iii) Clear the content of the (m+1)th row to zero.

(iv) Set I to "1" and start the process.

Step 2: If the content of the I-th signal register is
15 "0", it means that no data change has occurred in the objects of the group. Proceed to a step 4. If the content of the signal register is "1", set i to I_S and start the process from a step 3.

Step 3: Carry out the steps 2 to 5 of Fig. 5.

20 Step 4: Set i to i+1. If $i \leq N_I$, go to the step 3, and if $i > N_I$, go to a step 5.

Step 5: Set I to I+1. If $I \leq M$, go to the step 2, and if $I > M$, terminate the information updating.

(3) Optimization of grouping

25 It is important in reducing the number of times of check how the objects to be monitored are grouped. This is done by a batch process after the status monitoring. The process is carried out in the following

1 manner.

Step 1: A probability P_i of the status change in the updating time interval ΔT is determined based on a total time T_0 of the status monitoring and a frequency α_i of
5 the input buffer.

$$P_i = \frac{\alpha_i}{T_0} \Delta T$$

Step 2: Sort the objects of the management table in the descending order of P_i . Thus, the content of the management table is changed.

10 Step 3: Optimize the grouping so that the value K_2 is minimized.

Step 4: Store the top item number and the bottom item number of each group into I_S and I_E after the optimization of the grouping.

15 The speed-up when the process is divided as the objects are grouped is now explained.

When the processing F_j can be divided to

$$F_j = fj_1 \oplus fj_2 \oplus \dots \oplus fj_M$$

as the objects are grouped, only fi_I whose signal flag
20 representing the status change in the group I is "1" need be updated. In the above formula, \oplus indicates that the processing Fi can be divided.

Fig. 8 shows a format of the management table

1 used in the speed-up processing. In Fig. 8, the element
(i, j) ($i=1, \dots, M$, $j=1, \dots, n$) of the matrix contains
 f_i^j when F_i requires to process f_j^i while using the
information of the objects included in the group i, and
5 contains "0" in other cases. The (n+1)th column contains
the signal flags indicating of the status change of each
group. The (M+1)th row contains "1" if data of any one of
 f_j^I of the j-th column has been changed. The (M+2)th
row contains the value of the final decision function F_j .
10 The data of the object corresponding to each group is
prepared separately from the management table.

The function of the input buffer 14 and the method
for fetching data from the input buffer are the same as
those in the processes of Figs. 6 and 7. The updating of
15 the decision making support information is carried out in
the following manner as shown in Fig. 9.

Step 1: Carry out the initialization as follows.

- ① Fetch input buffer information
- ② Clear the data change flag of the input buffer
20 and the signal flag of each group to zero.
- ③ Clear the (M+1)th row of the management table to
zero.
- ④ Set I to "1" and start the following steps.

Step 2: If the element (I, n+1), that is, the signal
25 flag of the group is "0", it means that there is no change
in the objects of the group. Go to a step 6. If the
element (I, n+1) is "1", set j to "1" and go to a step 3.

- 1 Step 3: If the element (I, j) is "0", it means that there is no process related to the group I in F_j . Go to a step 5. If the element (I, j) is "1", it means that the processing of f_j^I is required. Go to a step 4.
- 5 Step 4: Process f_j^I , store the result in the element (I, j) and set the decision making support information updating flag by setting the element $(M+1, j)$ to "1".
Step 5: Set j to $j+1$. If $j > n$, go to a step 6. If $j \leq n$, go to a step 3.
- 10 Step 6: Set I to $I+1$. If $I > M$, go to a step 7. If $I \leq M$, go to a step 2.
Step 7: For all F_j whose elements $(M+1, j)$ are "1", process F_j such that

$$F_j = f_j^1 \oplus f_j^2 \oplus f_j^3 \oplus f_j^4 \oplus \dots \oplus f_j^M$$

- 15 The expansion to the case where the time serial data processing is required is now explained.

In the support system for the decision making based on the situation like the trading support system aimed by the present invention, the time serial data is frequently handled. The time serial data processing G_K includes a portion which requires current real time information and a portion which uses only past time serial data. When the time serial data processing can be divided into

1
$$G_K = G_K^R \oplus G_K^P$$

where G_K^R is a portion which depends only on the real time status change and G_K^P is a portion which depends only on the past time serial data, the processing time can be significantly reduced by precalculating the G_K^P and calculating only G_K^R corresponding to the status change on request basis. An embodiment of the real time decision making supporting processing in which the decision making support processing Fj requires the time serial data processing and it can be divided into

10

$$Fj = (fj)^R \oplus (fj)^P$$

where $(fj)^R$ is the portion corresponding to the status change and $(fj)^P$ is the portion which depends on the past time serial data, and $(fj)^R$ can be divided into

15
$$(fj)^R = (fj^1)^R \oplus (fj^2)^R \oplus \dots \oplus (fj^M)^R$$

to correspond to the grouping of the objects, is explained below.

Fig. 10 shows a format of the management table 10 used in the embodiment for the real time processing of the time serial data which requires the past data and the current data. It differs from Fig. 8 in that:

20

(i) a row for storing $(Fj)^P$ which comprises only

1 the past time serial data is provided, and
 (ii) The content of the element (I, j) is changed
 from fj^I to the processing $(fi^I)^R$ which depends only
 on the real time information.

5 The processing when the management table of Fig.
 10 is used is substantially identical to the flow shown in
 Fig. 9. The differences are:

(i) The calculation step for fj^I in Fig. 9 is
 changed to the calculation step for $(Fj^I)^R$ based on only
 10 the real time information.

(ii) The calculation step for

$$Fj = fj^1 \oplus fj^2 + \dots \oplus fj^M$$

in Fig. 9 is changed to the calculation step for

$$Fj = (Fj)^P \oplus (fj^1)^R \oplus (fj^2)^R \oplus \dots \oplus (fj^M)^R$$

15 by using $(Fj)^P$ calculated based on the past data stored
 in the table.

An embodiment of the present invention which
 calculates a correlation coefficient to a market variation
 of the retained portfolio on the real time basis is now
 20 explained. A market variable is usually represented by a
 stock price index and it is informed as one of marked
 quotation information. It is stored in the data base 9 of
 Fig. 1 as the time serial data (daily closing price). The
 time serial data string is given by

$$1 \quad (x_0, x_1, \dots, x_N)$$

where x_0 is a stock price index under the current situation. On the other hand, the current total amount f_j of the portfolio j is given by

$$5 \quad F_j = \sum_i \omega_{ij} P_j$$

The time serial data of F_i is given by

$$(y_0, y_1, \dots, y_N)$$

where y_0 is the value of the portfolio under the current situation, and y_1, y_2, \dots are calculated based on the
 10 daily closing stock prices of the firms, and the results thereof are stored in the data base. The correlation coefficient γ_j is given by

$$\frac{\sum_{i=0}^N x_i \cdot y_i}{\sqrt{\sum_{i=0}^N x_i^2} \sqrt{\sum_{i=0}^N y_i^2}}$$

It is divided into the portion calculated based on the
 15 current status data and the portion calculated based on the past data.

$$1 \quad r_j = \frac{x_0 y_0 + \sum_{i=1}^N x_i \cdot y_i}{\sqrt{x_0 + \sum_{i=1}^N x_i^2} \sqrt{y_0 + \sum_{i=1}^N y_i^2}}$$

The portions which depend on the past data are represented by

$$5 \quad \begin{aligned} A^1 &= \sum_{i=1}^N x_i y_i \\ A^2 &= \sum_{i=1}^N x_i^2 \\ A^3 &= \sum_{i=1}^N y_i^2 \end{aligned}$$

Since y_0 is calculated based on the current price P_i of the object in the following manner

$$y_0 = \sum_i \omega_{ij} P_i$$

10 the management table shown in Fig. 11 which is a merged one of Figs. 4 and 10 is utilized. Namely, a table which contains y_0 (portfolio current total amount), A_i^3 , $x_0 y_0$, A_i^1 , x and A_i^2 is added to the management table of Fig. 4. The processing which uses the table of Fig. 11 is
15 explained below.

1 (1) Preprocessing

Before the real time status monitoring of the objects is started, the content of the elements (i, j) ($i=1, \dots, m, j=1, \dots, n$) of the matrix as well as
5 A^1, A^2, A^3 are stored by utilizing the past time serial data.

(2) Real time status monitoring

The process of calculating the change flag for y_0 , and y_0 by noting the price change flag is the same as that
10 of Fig. 5. After the change flag for y_0 , and y_0 have been calculated, the following steps are carried out.

Step 1: If the status change flag to x_0 is "1", go to a step, otherwise go to a step 3.

Step 2: Calculate $x_0 y_0$ as the product of x_0 and y_0 for
15 $j=1, \dots, m$. Then, calculate

$$\gamma_j = \frac{(x_0 y_0 + A_j)}{\sqrt{x_0^2 + A_j^2} \sqrt{y_0^2 + A_j^3}}$$

for $j = 1, \dots, n$

Step 3: Calculate $x_0 y_0$ for only those whose change flags for y_0 are "1", and update γ_j by the above formula.

20 In this manner, the correlation coefficient γ_j can be calculated on the real time basis.

While the trading support system based on the market quotation information in the financial and security field has been described above, the present invention is

1 applicable to any real time status monitoring system and
method.

In accordance with the present invention, the
processing is done only for those objects whose data have
5 been changed as opposed to the checking of all status at a
constant time interval as is done in the multi-target
tracking. Accordingly, not only the data amount to be
processed is reduced but also the overall status of the
object under the varying status can be easily grasped
10 because it is easy to determine which decision making
support information has been changed.

The present invention is effective to the system
which monitors on the real time basis the function values
which vary with the status of randomly changing data of
15 different kinds.

CLAIMS

1. A real time status monitoring method comprising:
 - a first step of inputting a plurality of randomly varying data relating to a plurality of types of objects,
 - a second step of grouping the data;
 - a third step of preparing and grouping real time status management tables indicating which ones of the data a plurality of functions use as variables;
 - a fourth step of generating group data change flags indicating which group data of said data have been changed;
 - a fifth step of determining variables which are subjects of processing due to data change and types of functions which include such variables based on a function processing and flag indicating on which ones of the data the processing of the functions has been completed, and the group data change flag;
 - a sixth step of processing only those functions which include the variables which are subjects of processing due to the data change, based on the determination result;
 - a seventh step of generating the function processing end flag indicating on which ones of the data the processing of the functions has been completed, based on the processing of the functions in the fifth step; and
 - an eighth step of displaying the processing result of the functions.

2. A real time status monitoring method according to claim 1 wherein said data are grouped in accordance with a frequency of data change for the plurality of types of objects.

3. A real time status monitoring method comprising:
a first step of inputting a plurality of randomly varying data relating to a plurality of types of objects;

a second step of grouping the data;

a third step of dividing a plurality of functions including some of the data as variables into a plurality of types of sub-functions in accordance with the grouping of the input data;

a fourth step of preparing a management table indicating which ones of the sub-functions the functions use for processing;

a fifth step of generating a signal flag indicating which ones of the sub-functions relate to data change;

a sixth step of determining sub-function which are subjects of processing and types of functions which include such sub-functions based on a decision making support information change flag indicating on which ones of the sub-functions the processing of the function has been completed and the signal flag;

a seventh step of processing only those functions which include the sub-functions which are subjects of processing due to the data change, in accordance with the determination result;

an eighth step of generating the decision making support information change flag indicating on which ones of the sub-functions the processing of functions has been completed, based on the processing of the functions in the seventh step; and

a ninth step of displaying the processing result of the functions.

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Examiner's report to the Comptroller under
section 17 (The Search Report)

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Relevant Technical fields

(i) UK CI (Edition K) G4A (AUA, AUX), G4Q (QAH, QBT)

(ii) Int CI (Edition 5) G06F, H04L, B61L, G08G

Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner

M J DAVIS

Date of Search

24 FEBRUARY 1992

Documents considered relevant following a search in respect of claims

1-3

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
	None	

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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